1988

Energy in Perspective Laboratory #6: Induction -- Guessing a General Relationship from Specific Numerical Data

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Guessing a General Relationship from Specific Numerical Data

Exploration Activity

An ADAPT student used a mechanical device to lift some heavy load. She recorded the following results:

Effort She Exerted	Load She Lifted
10 lb.	410 lb.
22 lb.	520 lb.
33 lb.	620 lb.
45 lb.	730 lb.
60 lb.	860 lb.
77 lb.	1000 lb.
97 lb.	1200 lb.

1) Describe a method by which the student could determine the GENERAL relationship between the load she lifted and the effort she exerted. Is there more than one way that she could do it?

2) Decide on a method for your group.
Use it to determine the general relationship between load and effort.

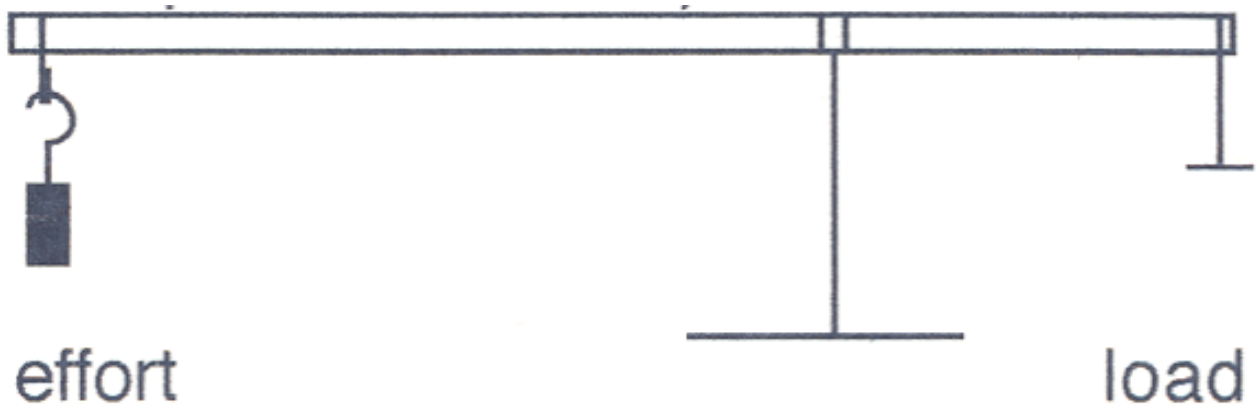
3) Use your results to predict the load she could lift if she exerted an effort of 50 lb.
What about 115 lb?

When all the members of your group have answered all three of these questions, invite an instructor to check your work and give you the next page.

Concept Invention

We characterize the relation you have obtained as ***empirical.*** It is based on the facts, the numerical observations a student made, and is not derived or deducted from some underlying theory. Our reasoning in drawing a general empirical statement from a few specific numerical cases is described as ***inductive*** as opposed to ***deductive.*** Inductive reasoning is the inferring (or guessing) of a general rule from particular instances or examples. Deductive reasoning goes in the opposite direction, starting with the general and ending with the particular.

Now obtain a set of equipment from the instructor (a metre stick, a fulcrum and masses.). Without changing the location of the pivot support, balance at least 7 different values of the load by the proper weight.



Determine the empirical relationship between the **load** you can lift on the **short** side of the pivot and the **weight** you put on the **long side** of the pivot.
(Hint: Plot the weight(effort) as the manipulated variable)

The pivot point is located at 14.3 cm from one end and 85.7 cm from the other end. Predict how much load could be lifted by an effort 50% large than the largest effort for which you collected data.

Show an instructor your empirical relationship and your prediction for approval, they you are ready for the next page.

Concept Application

Now what can you determine about the influence of the location of the pivot point on the relationship between the load lifted and weight applied?

To answer this balance at least seven different loads with the pivot point set at each of the following different locations:

12.5 cm, 16.7 cm, 20 cm, 25 cm, 33.3 cm, 50 cm

(That's **42** measurements that you have to take.)

For the write-up you **must** show the empirical relationship you determine for each set of data, i.e. seven sets in **all**!

Write-up:

I PURPOSE

II DISCUSSION

A) Determine the empirical relationships between load and effort for each pivot location. Make a table giving pivot point location and corresponding determined empirical relationship between load and weight. Be sure to include your initial measurements from the previous section, i.e. you should have seven graphs and seven different empirical relationships.

B) Describe the common features of all the empirical relationships found during the ***concept application*** activity.

III GENERAL RELATIONSHIP

A) Formulate the general relationship relating each empirical relationship to its pivot point location. (One relationship will explain all your measurements. You may find it helpful to consider the pivot point location as a fraction of the total length of the meter stick. That is, p.p.l. = 16.7cm is 1/6th from one end and 5/6ths from the other.)

B) How does the meter stick's weight influence the relationships you found?

C) Write out your answers to the ***Exploration*** questions.

IV CONCLUSIONS AND DATA

State any conclusions from the lab.
Include data sheets.

Bonus Points:

Can you develop a scheme to use your data to find the mass of the metre stick? Explain your scheme.